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CITRUS DECLINES CAUSED BY NEMATODES IN FLORIDA. IV. MANAGEMENT DECISIONS.

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In Florida, the management of nematodes on citrus has been mainly limited to the citrus nematode, Tylenchulus semipenetrans Cobb, the causal agent of slow decline of citrus, and the burrowing nematode, Radopholus similis (Cobb) Thorne, the causal agent of spreading decline. Methods used to contain the citrus nematode have included control measures such as pre- and postplant soil treatments with chemical nematicides, use of resistant rootstocks, and the production of nematode-free nursery stock required by site approval regulations. Attempts to eliminate or prevent the spread of the burrowing nematode from citrus groves have centered principally around "push and treat" programs, nematode-free nursery stock, resistant or tolerant rootstocks, and barriers, as well as restrictions of movement by regulatory activity. More recently, managing burrowing nematode-infected groves through cultural practices has received some attention.

The recent ban on several chemicals used for control of nematodes and the current lack of registered, economically feasible, alternative nematicides has severely curtailed certain of the pest management decisions for Florida citrus growers.

The nursery site certification program will continue to serve as the primary means of preventing introduction of these nematodes into noninfested areas. Use of nematode resistant and/or nematode tolerant rootstocks may serve an even more important role in management decisions.

Resistant rootstocks

Tylenchulus semipenetrans: A previous circular (7) discussed the four biological races of the citrus nematode, Tylenchulus semipenetrans, two of which occur in Florida. Rootstocks of importance in maintaining citrus nematode populations at low levels are Poncirus trifoliata (L.) Raf. cvs.: Argentina, Benecke, Christiansen, Christian. Kryder 5-5, English Large and Large Flower, Marks, Pomeroy, Rubidoux, and Towne G; a Citrus paradisi Macf. X P. trifoliata cv. Swingle citrumelo; and four hybrids from California, C. sinensis (L.) Osb. X P. trifoliata cvs: Ruby orange 13-7, 14-7, 15-7, and Nafertile orange 15-16 (8).

Radopholus similis (sensu lato): Two citrus rootstocks, C. limon (L.) Burm. f. cv. Milam and C. sinensis cv. Ridge Pineapple orange were released to the citrus industry in 1964 (2). Later C. webberi Ingr. & Moore cv. Carrizo and 'Algerian' navel orange were recommended as resistant rootstocks (3). These rootstocks proved to be highly resistant to the burrowing nematode and it was not until the early 1970's, after nearly 10 years, that a new nematode race appeared, as discussed in a previous circular (7). While these rootstocks are still effective against most citrus burrowing nematode populations, (Race 1), they are susceptible to the other population (Race 2) (4). At the present time, Milam or Carrizo rootstocks are recommended in the "push and treat" program or replant sites.

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Chemical Control

Preplant Treatment: Trees planted in infested soils from old groves are readily invaded with the surviving citrus-phytoparasitic nematodes. Therefore, preplant fumigation is important for the establishment of the young trees or for individual tree sites within a grove. In Florida, preplanting applications of nematicides have been found effective for nematode control. Applications by chisel injection of such chemicals as 1,3-dichloropropene give effective nematode control in most soils. Other compounds, such as methyl bromide, chloropicrin, ethylene dibromide, metam sodium, and DD-MITC, when properly applied, have also provided effective nematode control, particularly in nurseries or as tree site treatments. Unfortunately, several of these chemicals are not presently registered or available for use on citrus in Florida.

It is known that certain fumigants have a deleterious effect on vesicular-arbuscular mycorrhizal fungi, which are beneficial to citrus (5). Citrus mycorrhizae are widely distributed and citrus plants grow poorly, or not at all, when mycorrhizae are not present. Precautions must be observed when certain fumigants are used in replant or in nursery fumigation to prevent seedling growth suppression.

Postplant treatment: Treating living trees in place (Fig. 1) with chemical compounds not toxic to trees , but which provide effective nematode control, has spurred the testing of many compounds. DBCB (1,2-dibromo-3-chloropropane) had received widespread use by the citrus industry for citrus nematode control, but since the chemical has been found detrimental to humans, it is no longer registered for use. A search for alternate compounds has shown that several nonvolatile nematicidal compounds which provided nematode control, were not phytotoxic and resulted in yield increases.

Nonfumigant materials most actively investigated include aldicarb, carbofuran, diazinon, fensulfothion, oxamyl, and phenamiphos. Some nonfumigants can be incorporated with the soil, applied in irrigation water, or sprayed on foliage. These compounds are highly toxic to warm-blooded animals and must be handled with extreme caution. Because of lack of registration and/or restrictions limiting the use of nematicidal compounds, which seem to be constantly changing, recommendations for latest available formulations should be obtained from appropriate citrus extension specialists.

Cultural practices to combat the burrowing nematode

A previous circular (6) described the root distribution of citrus and stated that the greatest burrowing nematode damage to roots occurs below 30 inches (75 cm) in depth. Thus, roots in the topsoil are relatively free of the nematode and remain functional. It has been shown (1) that there are actually more roots in the topsoil under decline trees than under healthy trees. Cultural practices, such as discing or mechanical hoeing, destroy many functional roots, and reduce even further the root volume which is so important to the support of a diseased tree. Therefore, it is recommended that the surface soil be left undisturbed, and that the application of herbicides be used as an alternative to mechanical cultivation under trees which are afflicted with spreading decline.

Minimal rainfall from January through May puts additional stress on trees which have been weakened by the burrowing nematode. As a result, these trees will readily wilt, lose their leaves, and drop their fruit. The soils where spreading decline occurs are usually greater than 95% sand, the moisture holding capacity is in the range of 5-7%, and the permanent wilting point approximately 1.5-2%. Therefore, during the low rainfall months, trees must receive supplemental irrigation and the

soil must not be allowed to dry out. If adequate moisture is available during this period, trees will not suffer so severely and fruit drop will be lessened (Fig. 2).

The retention of soil moisture is heavily influenced by the content of organic matter in the soil. Addition of organic materials to soil that will increase its water-holding capacity is desirable but is not critical. If such compost material is available and can be economically applied, its use may be beneficial. In the past few years, excellent progress has been made where the above practices are combined with certain systemic chemicals which control both nematodes and some foliar pests.

Sanitation and site certification to maintain pest free conditions, especially in nurseries, have played a major role in preventing spread of the economically important pests.

LITERATURE CITED:

1. Ford, H. W. 1952. The effects of spreading decline on the root distribution of citrus. Proc. Fla. State Hort. Soc. 65:47-50.
2. _____, and W. A. Feder. 1964. Three citrus rootstocks recommended for trial in spreading decline areas. Fla. Agric. Exp. Sta. Circ. S-151.
3. _____, and _____. 1969. Development and use of citrus rootstocks resistant to the burrowing nematode, Radopholus similis. Proc. 1st Int. Citrus Symp.
4. Kaplan, D. T., and J. H. O'Bannon. 1985. Occurrence of biotypes in Radopholus citrophilus. J. Nematol. 17:158-162.
5. Kleinschmidt, G. D., and J. W. Gerdemann. 1972. Stunting of citrus seedlings in fumigated nursery soils related to the absence of endomycorrhizae. Phytopathology 62:1447-1453.
6. O'Bannon, J. H., and R. P. Esser. 1985. Citrus declines caused by nematodes in Florida. I. Soil factors. Fla. Dept. Agric. & Consumer Serv., Div. Plant Ind., Nematol. Circ. No. 114. 4 pp.
7. _____, and _____. 1985. Citrus declines caused by nematodes in Florida. II. Physiological races. Fla. Dept. Agric. & Consumer Serv., Div. Plant Ind., Nematol. Circ. No. 116. 4 pp.
8. _____, and H. W. Ford. 1977. Resistance in citrus rootstocks to Radopholus similis and Tylenchulus semipenetrans (Nematoda). Proc. Int. Soc. Citriculture 2:544-549.

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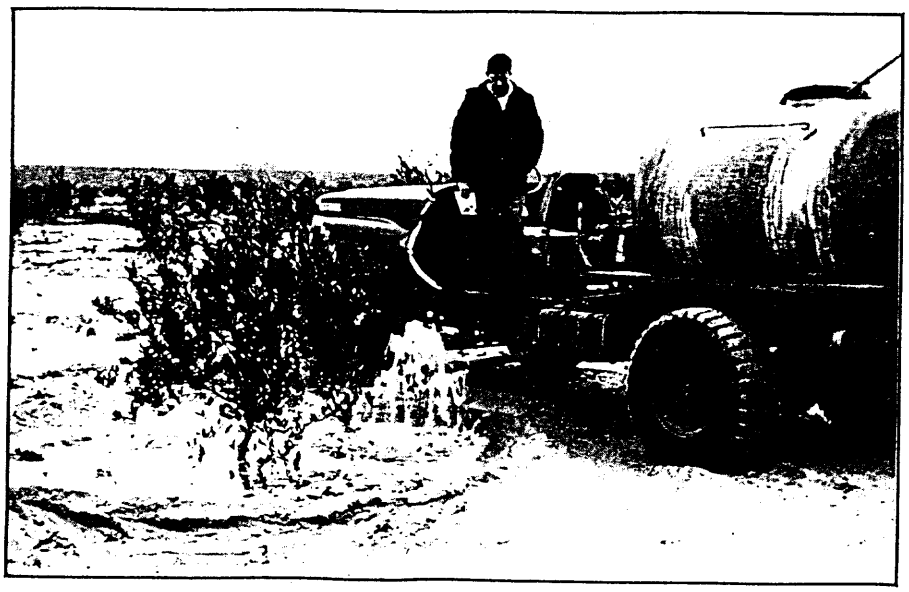

Fig. 1. Basin treatment of young trees with an emulsifiable nematicide.

Fig. 2. Two trees infected with the burrowing nematode. Tree on left is under a manageament program of supplemental irrigation and nontillage. Tree on right does not receive these practices.